

# Practical Approaches to Environmental Control

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**S H E L B U R N E  
M U S E U M**

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# Shelburne Museum

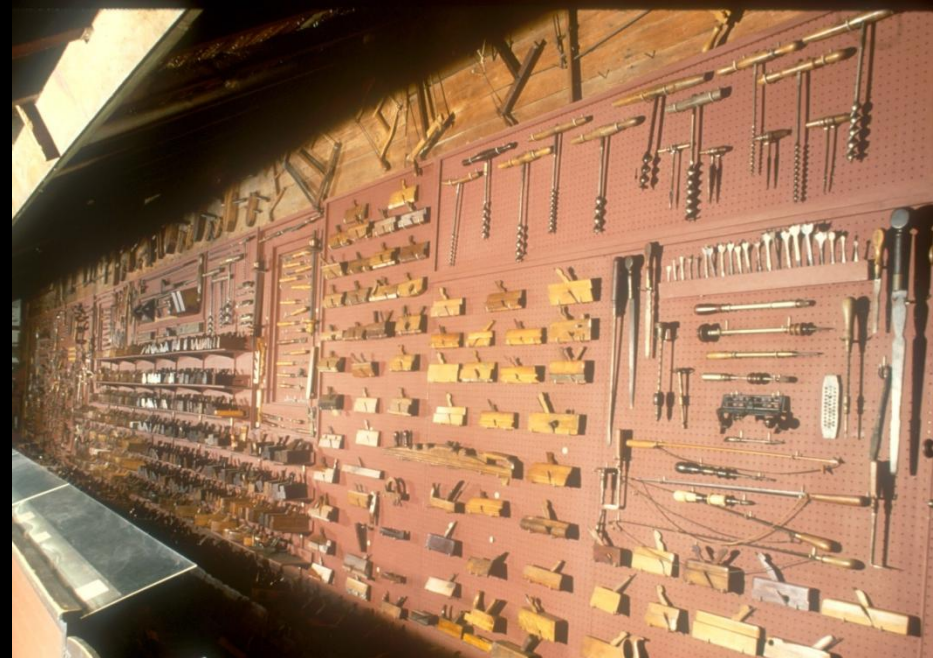




Shaker  
Shed



General  
Store









Dutton House



# Class 1: Open Structures



Covered Bridge



Locomotive 220



# Class 2: Sheathed Post and Beam Structures



Horseshoe Barn



## Class 3: Framed Wood or Uninsulated Masonry Structures



Prentis House



## Class 4: Tight Wooden or Heavy Masonry Structures



Dorset House



# Class 5: New-built Insulated Structures, Vapor Barriers



Pleissner Gallery



# Class 6: Double-wall Construction, Storage Vaults



Museum Library

# Dust Control - Calcium Chloride





# Moving Water Away from Buildings





# Sealing Buildings





# Interior Storm Windows









Tinting Blocks  
80% of Light

Tinting Blocks  
60% of Light

Tinting Blocks  
90% of Light

Blind is pulled down  
when the Museum  
is closed

No Tinting -  
Invisible UV Light Blocked

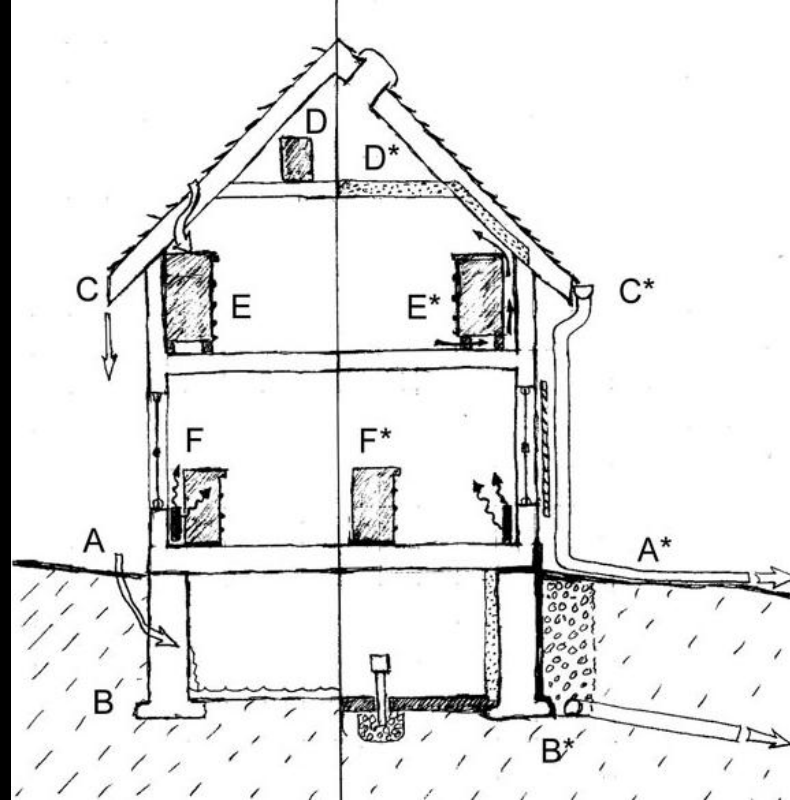
Black Foamcore board  
covers windows when buildings  
are closed for the season

# Insulation









Sources of incorrect RH around sites and buildings (left half) and their control (right half, with an asterisk).

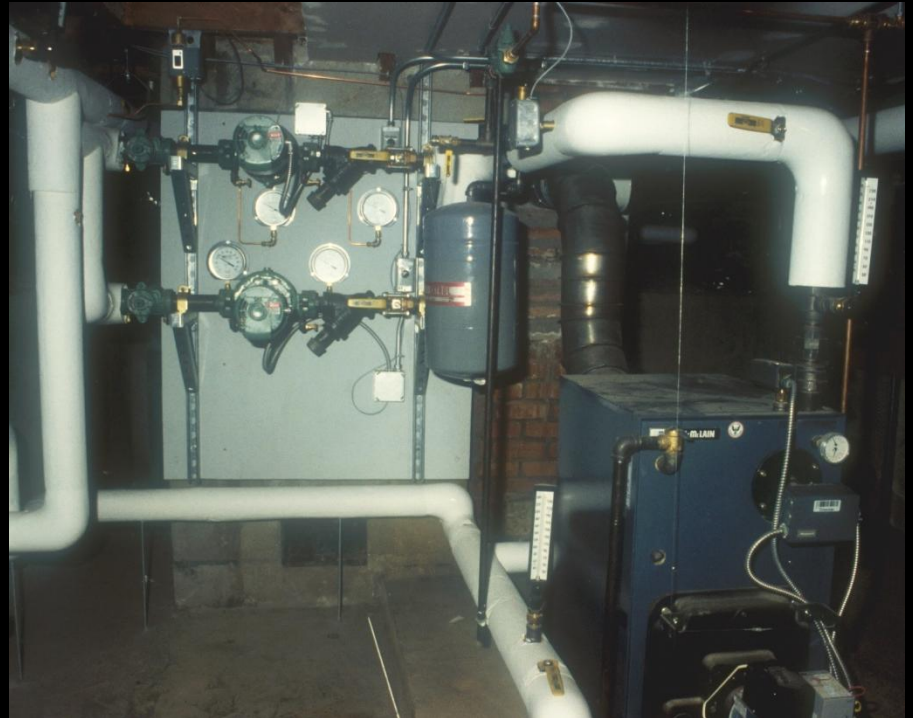
- A surface drainage
- B soil drainage
- C rainwater
- D hot attics
- E exterior walls
- F heating systems



# Conservation Ventilation (humidistatically controlled)



# Conservation Heating (humidistatically controlled)







Prentis House

Chemical sensitivity of materials to room temperature				
	Low sensitivity	Medium sensitivity	High sensitivity	Very high sensitivity
	Wood, glue, linen, cotton, leather, rag paper, parchment, oil paint, egg tempera, watercolour media, and gesso. Serviceable examples of all these exist that are 1–3 millennia old from dry burial or dry enclosures at ~20°C. These examples were protected from any acid exposure, such as air pollution in the Industrial Revolution, and have never been damp. Skin, bone, and ivory of the Woolly mammoth have survived intact for over 40 millennia while frozen.	Current best estimate for stable photographic materials to remain usable as images with little or no change, e.g. 19th century black-and-white negatives on glass, 20 <sup>th</sup> century back-and-white negatives on polyester film.	Acidic paper and some film become brittle and brown, difficult to access, e.g. newsprint and low-quality books, papers, post-1850. Acetate film shrinks, image layer cracks. Celluloid and many early plastics, become yellow, crack, distort. Natural materials acidified by pollution (textiles, leather) weaken, may disintegrate.	So-called "unstable" materials. Typical magnetic media begins to be unplayable, e.g. tapes of video, audio, data; floppy discs. Least stable of the photographic materials decay, e.g. colour prints fade (in the dark), poorly processed items yellow, disintegrate; cellulose nitrate yellows, disintegrates, faster when packaged in large amounts. Many elastic polymers, from rubber to polyurethane foams, become brittle, or sticky, or disintegrate. Some acrylic paints on some canvas supports yellow rapidly.

25°C = 77°F

20°C = 68°F

10°C = 50°F

0°C = 32°F

Approximate lifetimes* of the materials at various temperatures				
Heat treat, sun ~60°C	~4+	~1	~6 months	2 months
Hot room ~30°C	~250 yr+	~75 yr	~25 yr	~7 yr
Warm room ~25°C	~500 yr+	~150 yr	~50y	~15 yr
<b>Normal room ~20°C</b>	<b>Millennia ~1,000 yr+</b>	<b>A few centuries ~300 yr</b>	<b>One human lifetime ~100 yr</b>	<b>One human generation ~30 yr</b>
Cool store ~10°C	~5,000 yr+	~1,500 yr	~500 yr	~150 yr
Cold store ~0°C	20,000 yr+	~6,000 yr	~2,000 yr	~600 yr



*“Overall, low temperature is beneficial to collections, but polymeric materials, such as paints, become more brittle and fragile. Fortunately, careful handling mitigates most of the risk.”*

### Careful handling

*“Because artists acrylic paints enter their glassy state below 40°F and oil paintings enter their glassy state below -22°F, paintings are more vulnerable to shocks and blows below these temperatures than at room temperature.”*

Michalski, 2009

# Modified Use of Conventional HVAC Systems



## Hat and Fragrance Unit

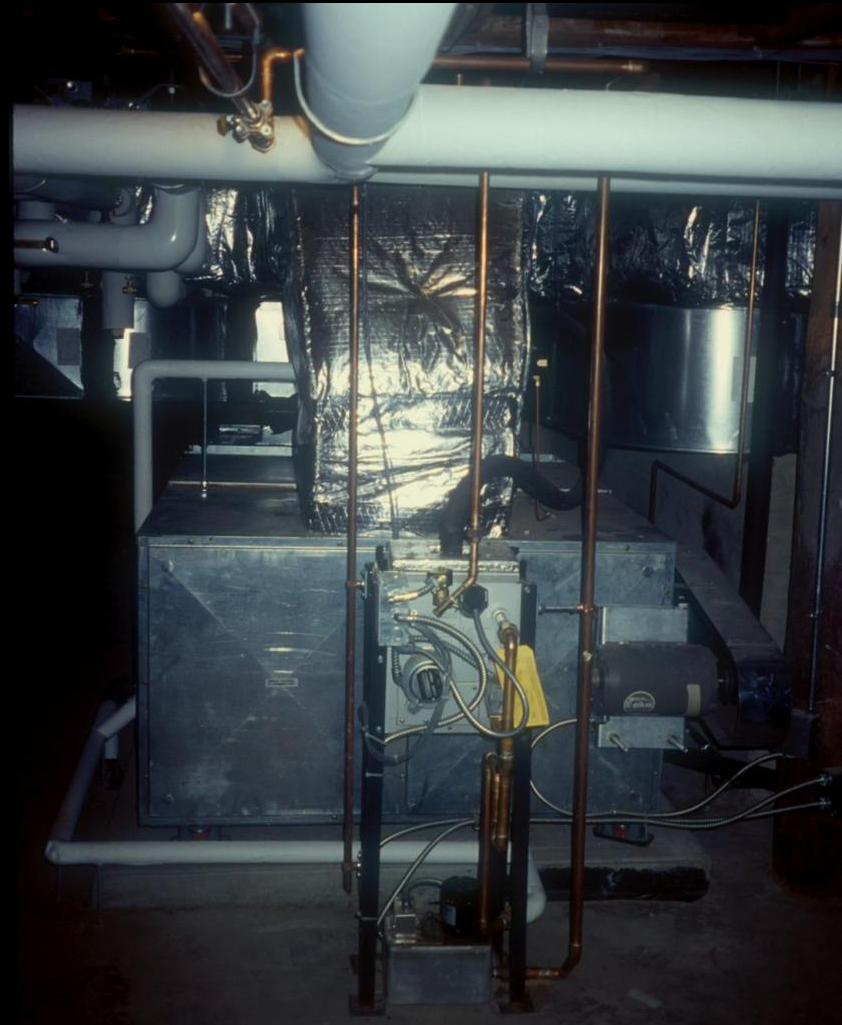




# Conventional HVAC System with Low-Level Humidification



Stagecoach Inn



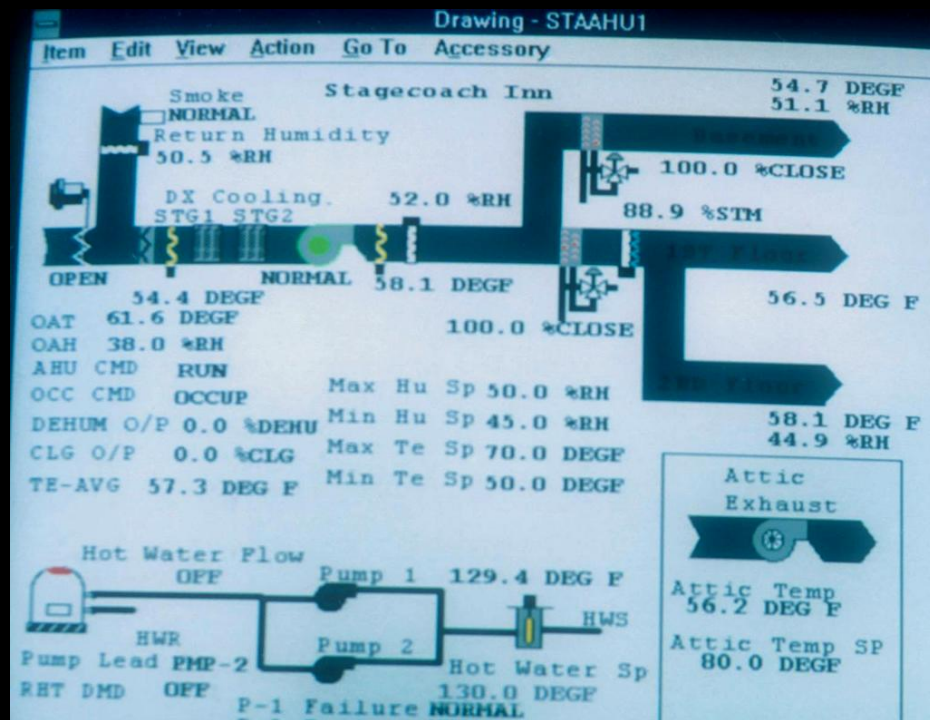
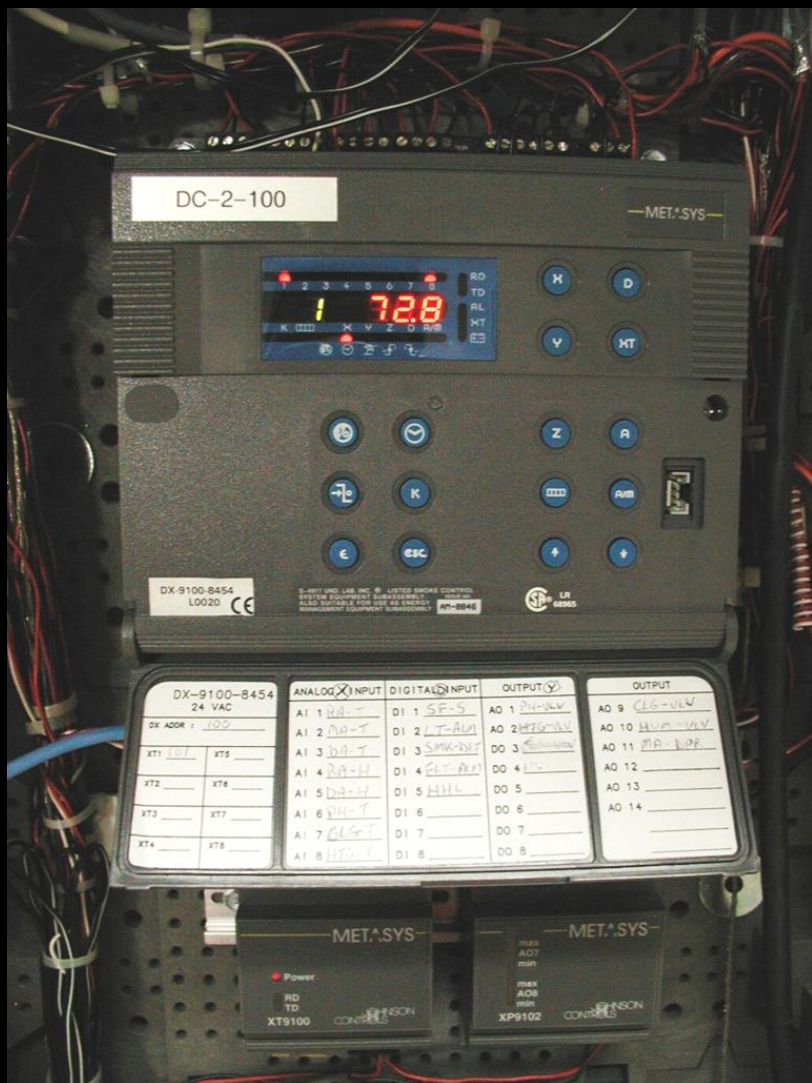
$OT > 32^{\circ}\text{F}$  = 45%RH

$32^{\circ}\text{F} > OT > 20^{\circ}\text{F}$  = 40%RH

$OT < 10^{\circ}\text{F}$  = 35%RH



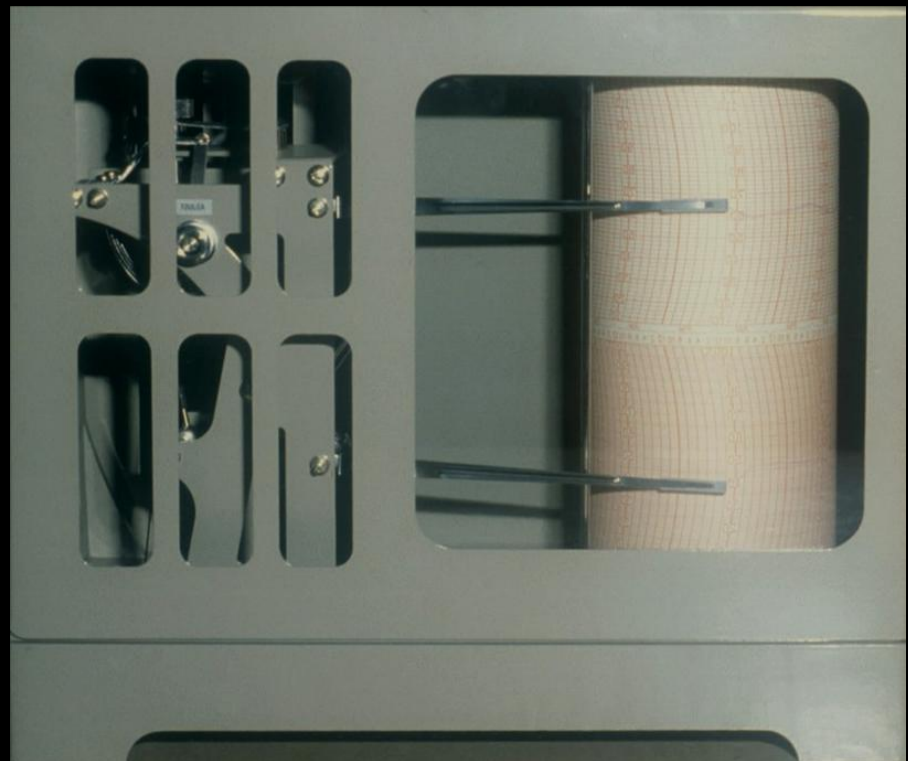








# Vaisala RH Sensor



# Practical Environmental Control for Newer Buildings



Collections Preservation Building















# Conservation Heating with DX Cooling



Decorative Arts Storage



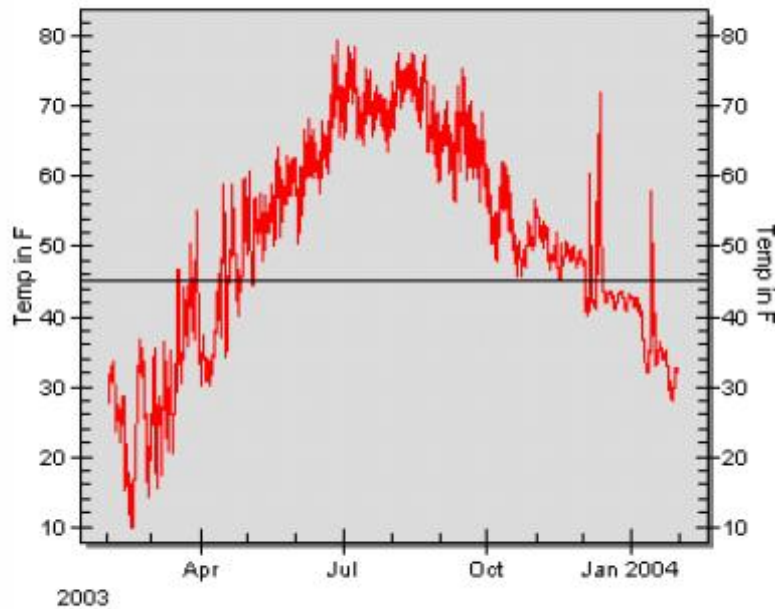






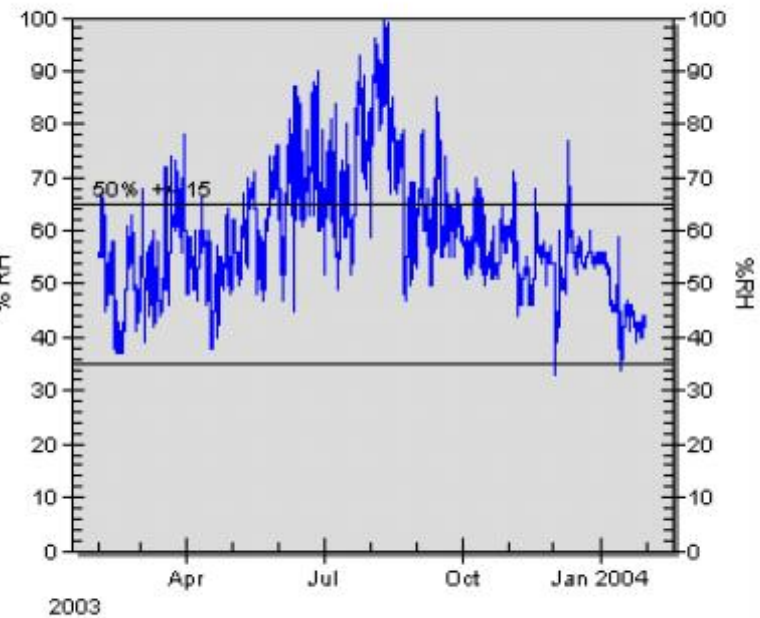
# Decorative Arts Storage T and RH 2003

Temperature



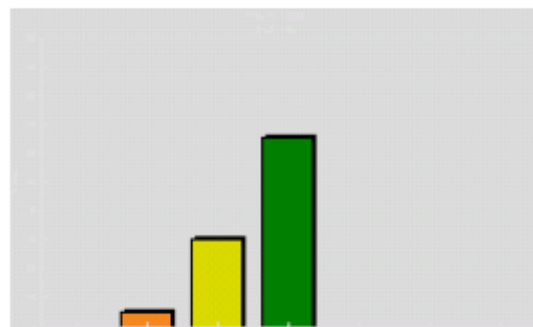
Temp Performance Target : 65 F +/- 20F

Relative Humidity

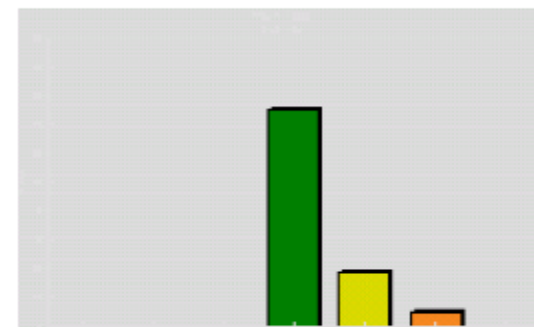


RH Performance Target: 50% RH +/- 15%

Actual Temp vs Target



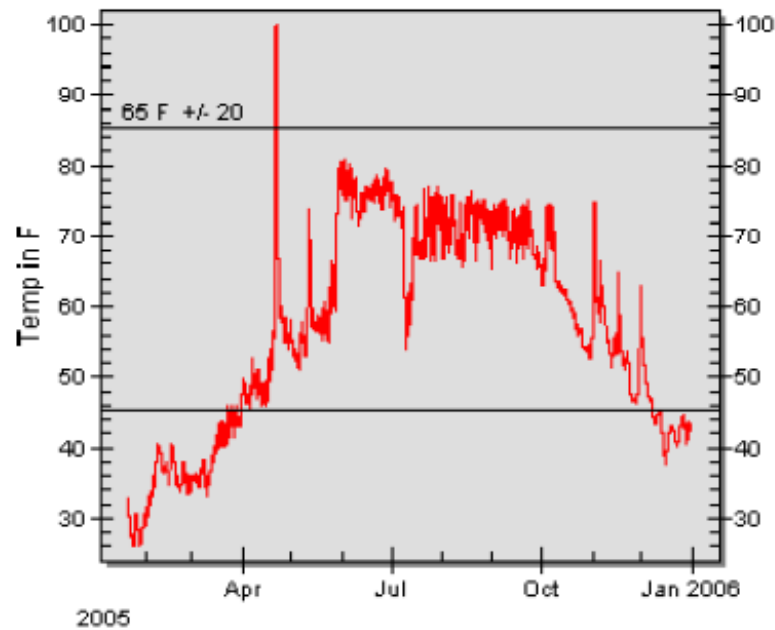
Actual RH vs Target





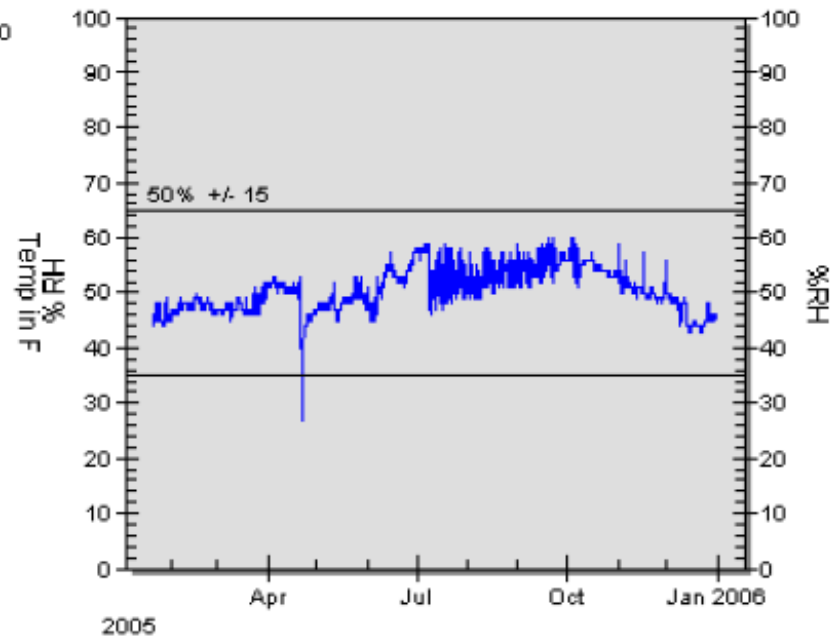
# Decorative Arts Storage T and RH 2005

Temperature



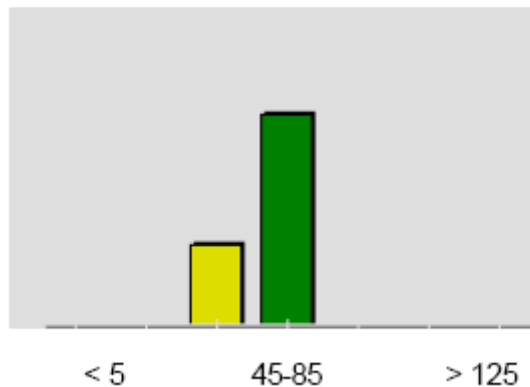
Temp Performance Target : 65 F +/- 20F

Relative Humidity

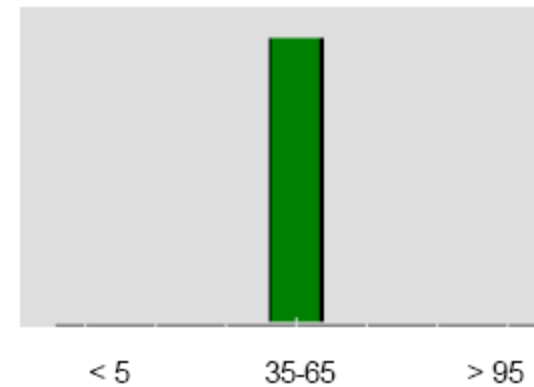


RH Performance Target: 50% RH +/- 15%

Actual Temp vs Target



Actual RH vs Target



# Circus Building







# Mr. Slim® Split-ductless Systems

## Redefining Comfort

R410A  
**INVERTER**



M-Series Indoor Unit



Wireless  
M-Series Remote



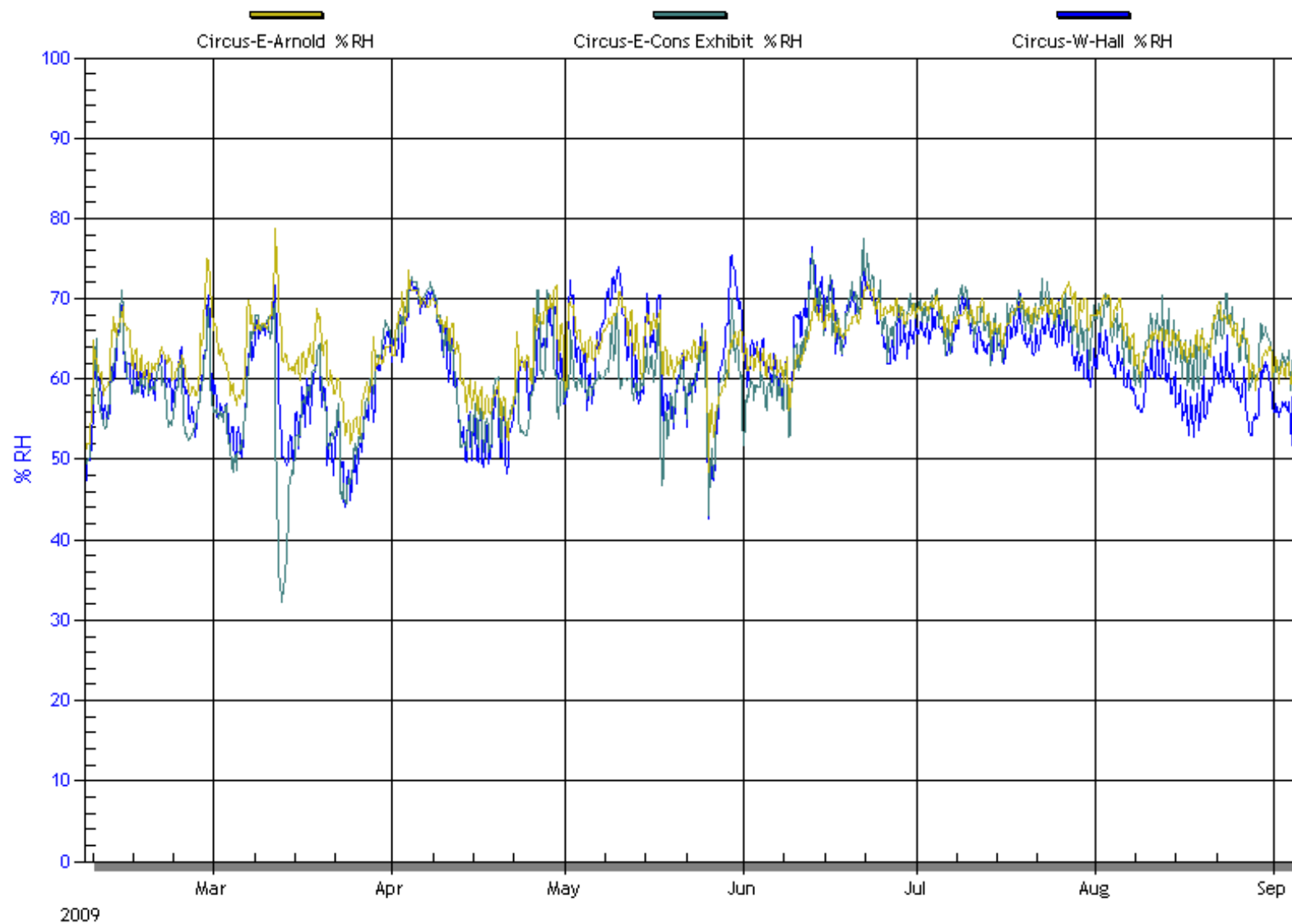
M-Series Outdoor Unit





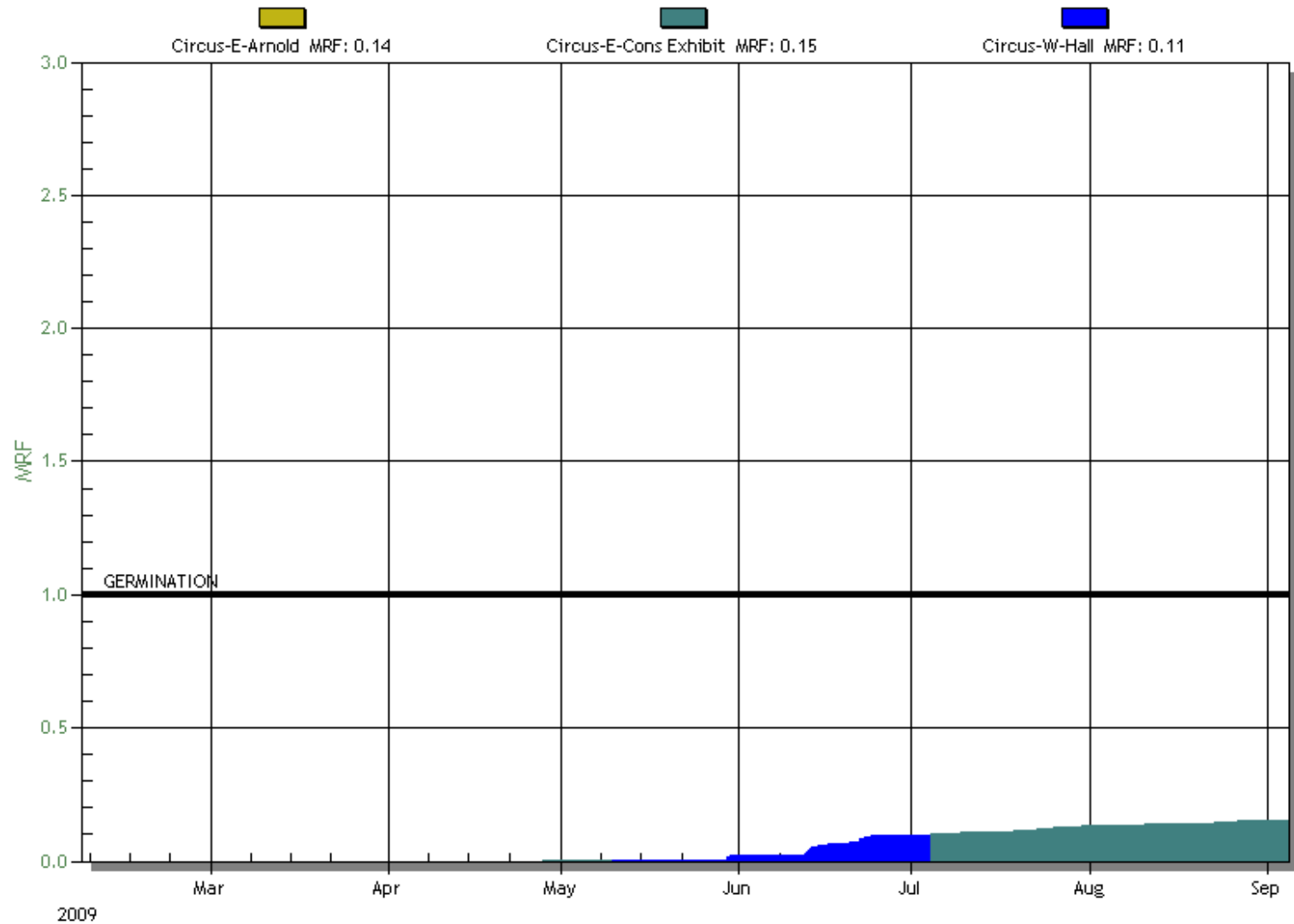
% RH of Circus-E-Arnold et al.

2009-02-06 - 2009-09-04



# Mold Risk Factor of Circus-E-Arnold et al.

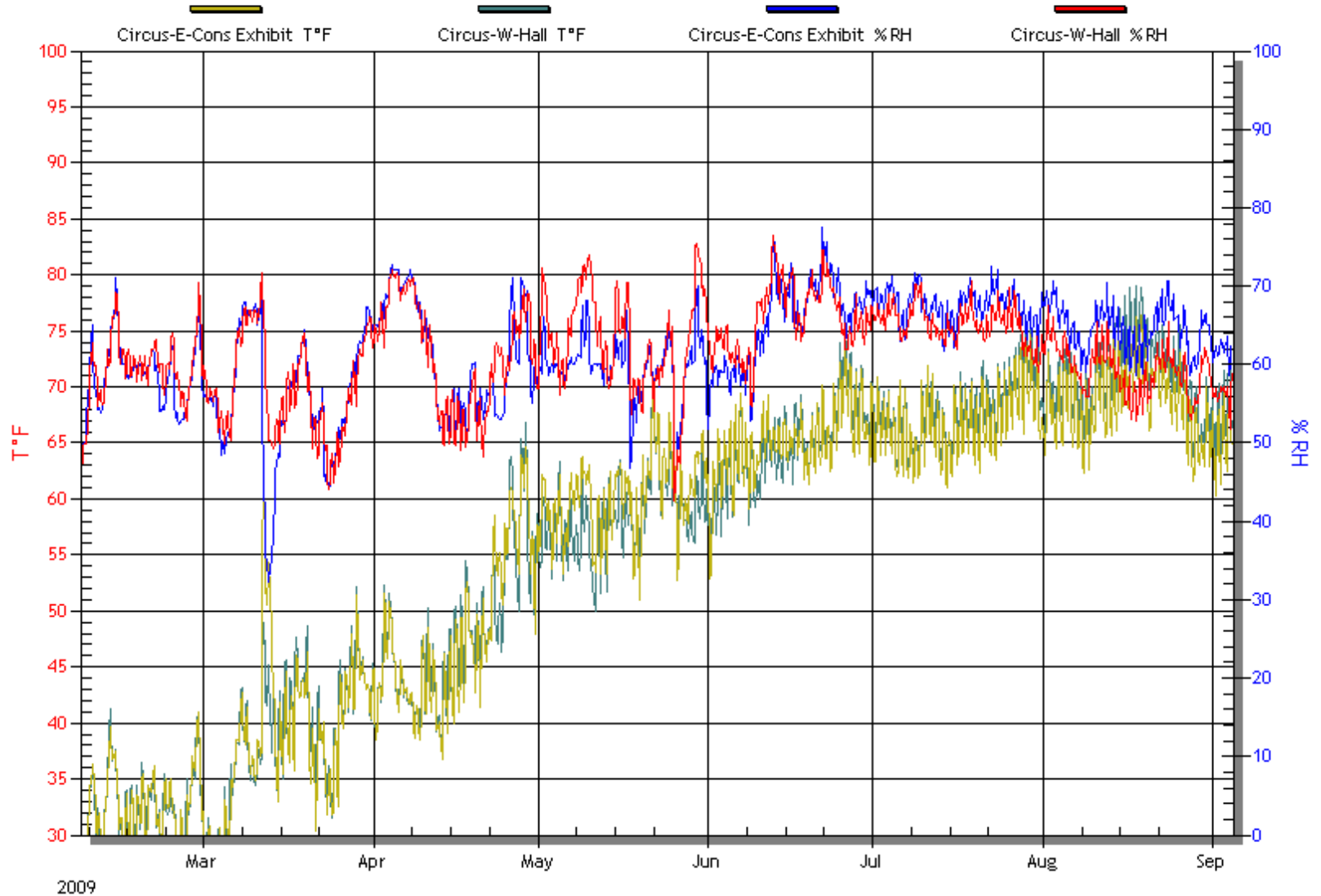
2009-02-06 - 2009-09-04





# T °F and % RH of Circus-E-Cons Exhibit et al.

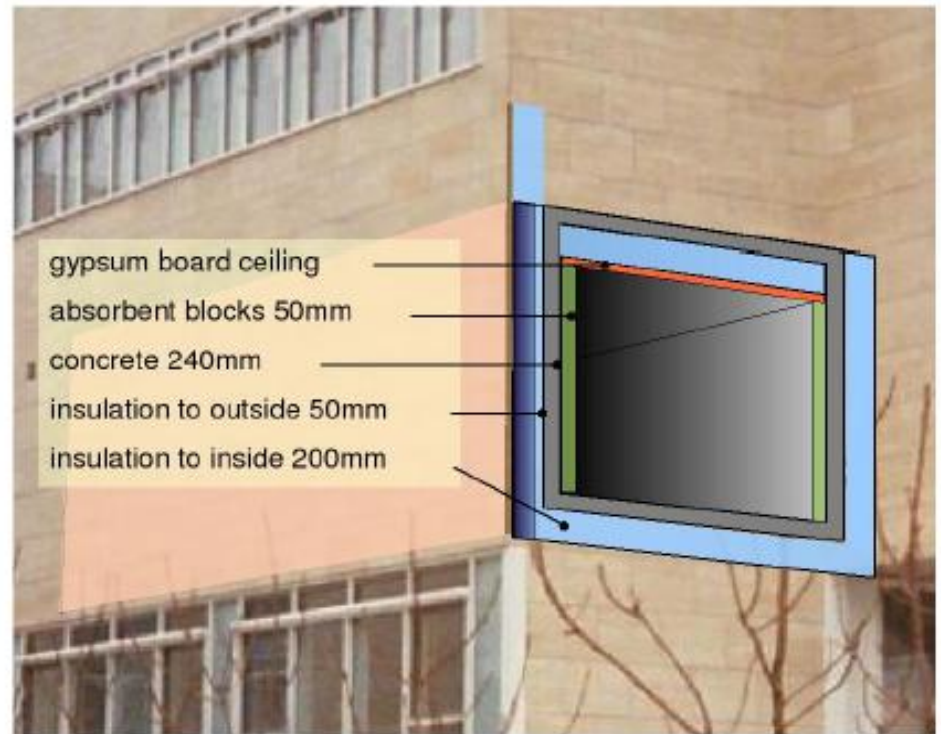
2009-02-06 - 2009-09-04



# Simple Climate Control in Archives

by Tim Padfield

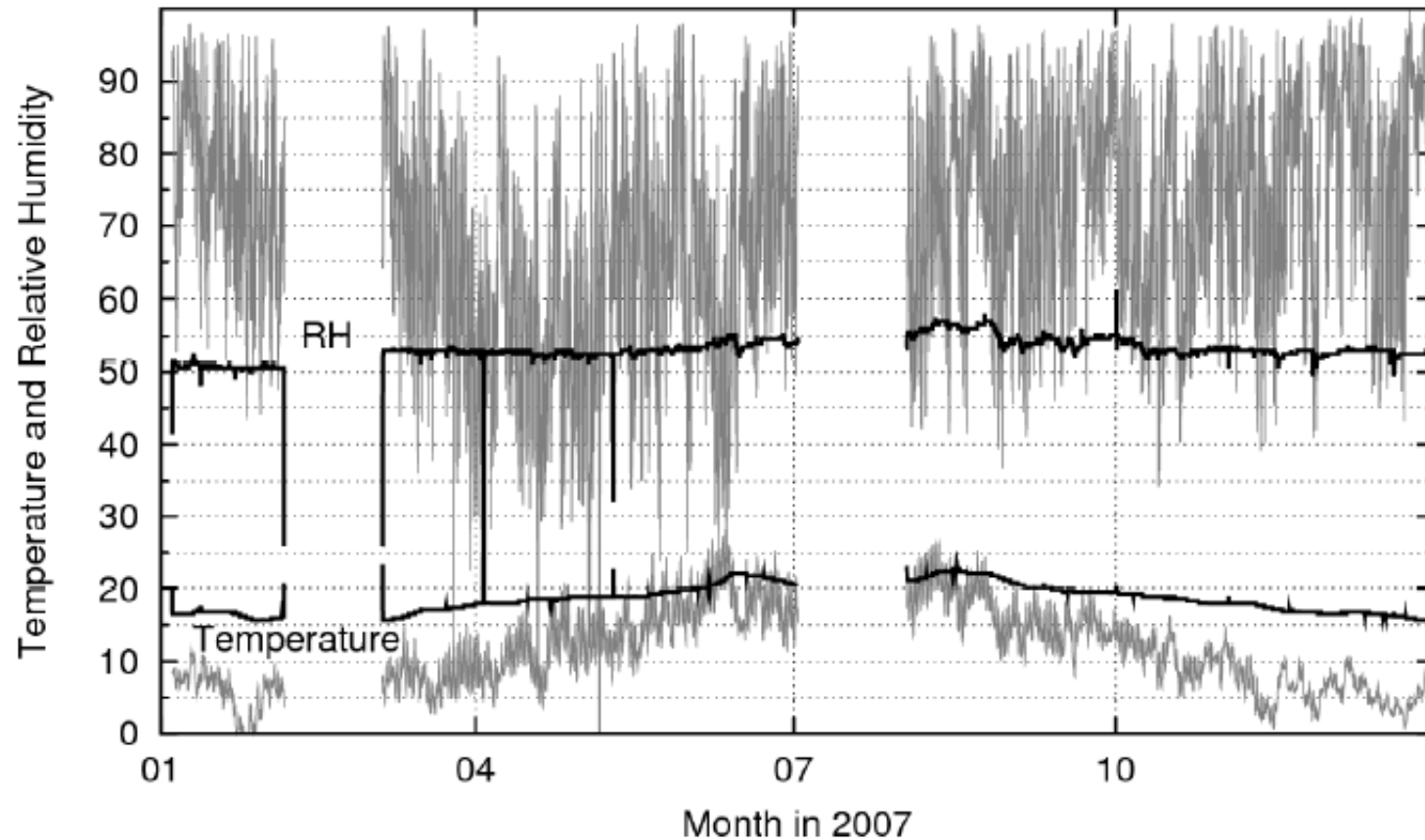
[www.conservationphysics.org](http://www.conservationphysics.org)



*FIG. 1: The archive of the Arnemagnaan Institute of Copenhagen University is concealed behind the windowless area of the building (left). The archive, sectioned in the right hand picture, is insulated against both the internal and the outdoor temperature, so that its temperature is always about half way between the constant 22°C of the building and the variable outdoor temperature.*



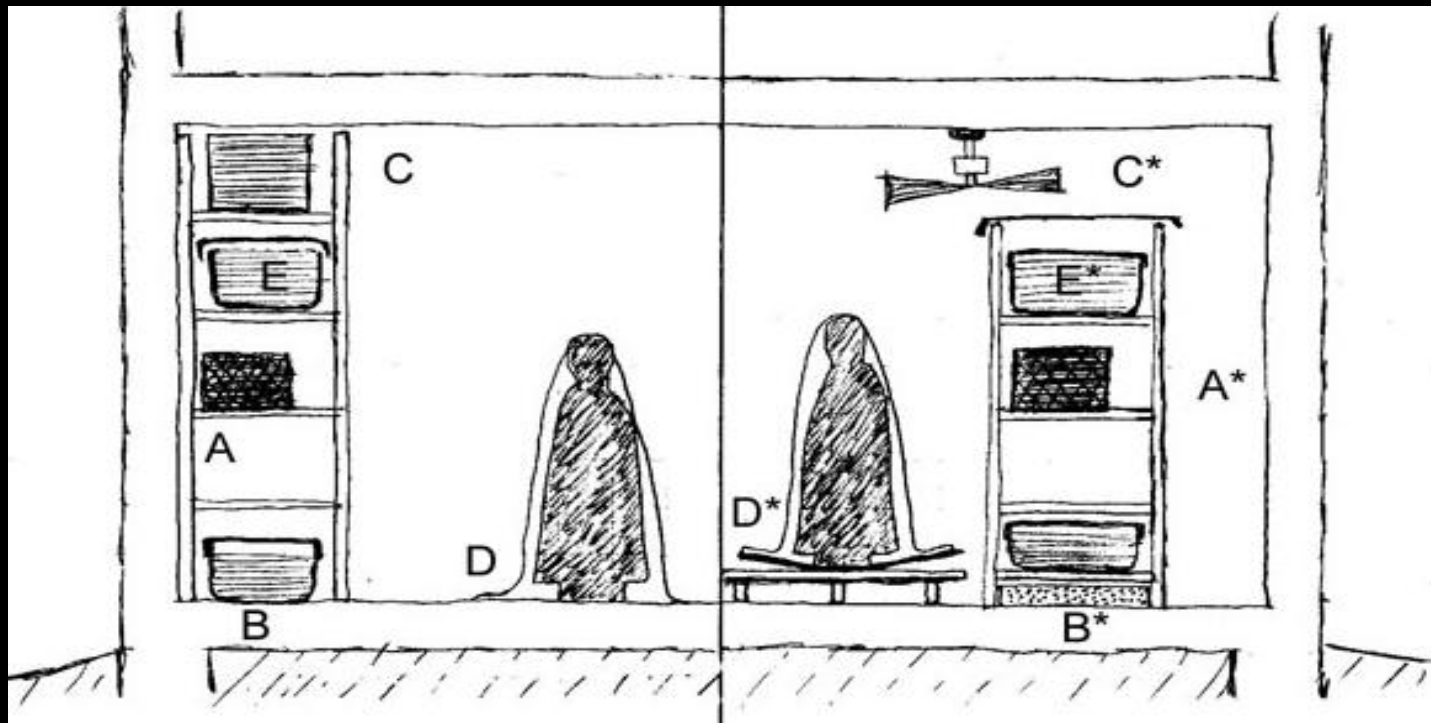
Tim Padfield  
[www.conservationphysics.org](http://www.conservationphysics.org)



*FIG. 2: The climate in the Arnemagnaeen archive during 2007 (bold traces), compared with the outdoor climate (the jagged grey traces). [Jakobsen 2008]*

# Incorrect Relative Humidity by Stefan Michalski

<http://www.cci-iic.gc.ca/crc>



Sources of incorrect RH associated with fittings and packaging (left half) and their control (right half, with an asterisk).

- A fittings placed near exterior walls
- B fittings placed near cold damp floors
- C fittings placed near hot dry ceiling
- D dust cover draped over damp floor
- E semi-airtight packaging



# INSTITUTE OF MUSEUM AND LIBRARY SERVICES

## CONSERVATION ASSESSMENT PROGRAM

Application Deadline Usually December 1

General collection assessments  
including environmental conditions

## CONSERVATION PROJECT SUPPORT GRANT

Application Deadline Usually October 1

Up to \$150,000 (Match 1:1)

Supports environmental surveys and improvements  
and storage improvements

# NATIONAL ENDOWMENT FOR THE HUMANITIES PRESERVATION ASSISTANCE GRANTS

Application Deadline Usually MAY 15

Up to \$6000 no match required

Environmental surveys, purchase of monitoring equipment

## SUSTAINING CULTURAL HERITAGE COLLECTIONS

Application Deadline Usually December 7

Up to \$40,000 for Planning Grants (80% of total project costs)

Up to \$400,000 for Implementation Grants (50% of total project costs)

Install or re-commission HVAC Systems

Manage interior RH and Temperature by passive methods



# Reference List

ASHRAE Handbook -- HVAC Applications. 2009. "Chapter 21: Museums, Galleries, Archives and Libraries. ASHRAE.

Institute of Museum and Library Services. Grant Applicants, Available Grants: Conservation Project Support.  
<http://www.imls.gov/applicants/grants/conservProject.shtm>

Michalski, Stefan. 2009. "Incorrect Relative Humidity."  
In *Ten Agents of Deterioration*. Ottawa: Canadian Conservation Institute.  
<http://www.cci-iic.gc.ca/crc/articles/mcpcm/chap10-eng.aspx>

National Endowment for the Humanities. Grant Programs and Deadlines: Sustaining Cultural Heritage Collections.  
<http://www.neh.gov/grants/guidelines/SCHC.html>

Padfield, Tim. 2008. "Simple climate control in archives."  
Conservation Physics-Index, Recent items.  
<http://www.conservationphysics.org>